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ENVIRONMENTAL TESTING OF CANISTER ASSEMBLIES FOR 81-mm M853A1 WHITELIGHT ILLUMINATING MORTAR CARTRIDGE PACKAGED IN M548 METAL CONTAINER

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This report details the engineering test and evaluation program to qualify a metal container packaging (drawing 12977137) that is needed for interplant shipment and storage of canister assemblies for the 81-mm M853A1 Whitelight Illuminating Mortar Cartridge. The test results verified that the package design met the Level B requirements of MIL-STD-1904. The package is also used for shipment and storage of canister assemblies for M816 Infrared Illuminating Cartridge.

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OBJECTIVE

The objective is to conduct environmental rough-handling tests on the canister assembly for 81-mm M853A1 Whitelight Illuminating Cartridge packaged in M548 sealed metal container.

BACKGROUND

The Long Horn Army Ammunition Plant (LHAAP) in Marshall, Texas historically manufactured the candle assemblies for 81-mm M853A1 Whitelight Illuminating Mortar Cartridge and loaded it in the end item. Under this scenario, no candle shipping was required. Starting in FY 95, however, the Army decided to close LHAAP and move its production capabilities to Pine Bluff Arsenal (PBA) in Pine Bluff, Arkansas. As a result, the final loading, assembling, and packing (LAP) operation for the M853A1 Illuminating Cartridge as well as the incoming 81-mm XM816 Infrared (IR) Illuminating Cartridge will take place at PBA. That will, in turn, procure the candle assembly from Crane Army Ammunition Activities (CAAA) in Crane, Indiana as a component part. Thus, interplant packaging instruction is now required. As such, environmental transportation and handling tests were performed on the packaged configuration to validate the design and is the basis for this report.

INTRODUCTION

Six M548 metal containers were each packed with 20 candles with foam cushioning systems. Every individual candle was separated by fiberboard partitions that were designed as isolators for each body assembly to avoid possible damage created by vibration and movement among body assemblies during shipment and storage. Each candle weighed approximately 2.4 lb and the weight of the metal container was 20 lb. The total weight of the packed container was approximately 72 lb. Two of the six containers were successfully tested for seal integrity at 3 psig at ambient temperature. Three M548 metal containers were tested at +160°F and three M548 containers were tested at -65°F after 24 hrs of conditioning at these temperatures. All six packages provided proper protection to the candle assemblies. During loose cargo vibrations, the fiberboard filler rings used to fill the canister became loose. However, based on the facts that the loose filler rings were only secured by office-grade scotch tape, caused no damage to the candle, and could be easily fixed by hand, it was decided that it should not be considered as a defect. All six containers successfully passed sequential environmental transportation and handling tests (app).

TEST PROCEDURE AND RESULTS

Tests Conducted at 160°F

Three M548 containers were subjected to secured cargo vibration at +160°F. The three containers were secured to the vibration table with straps and vibrated in the transverse, longitudinal, and vertical axes representing composite spectrums for wheeled vehicle, tracked vehicle, and trailer in accordance with ITOP 1-2-601. After the test, the three containers showed no damage. The candles were also visually inspected and no damages were found. The three containers were then reconditioned at +160°F for 24 hrs.

These three containers were then drop tested in accordance with MIL-STD-1904 from a height of 3 ft in six different orientations at +160°F. The six different orientations are flat side, flat end, cover down vertical, bottom down vertical, 45 deg cover down, and 45 deg bottom down. After the drop tests, the containers were in excellent condition with only minor scratches. The candles were also visually inspected and no damages were found. The containers were then reconditioned at +160°F for 24 hrs.

These three containers were then subjected to loose cargo vibration in accordance with MIL-STD-1904 at +160°F. The three containers were vibrated together on a steel plate on a loose cargo platform with 1 in. double amplitude synchronous orbital motion at 300 rpm for 20 min. The containers successfully passed this test with minor scratches. One of the three containers was successfully tested fo seal integrity to 3 + 0.5 psig. The candles were visually inspected with no damage found. It was noticed that the fiberboard filler rings used to fill the canister became loose. The Infantry Branch engineer explained that the main function of the filler rings was to fill up the space of the canister and also to provide protection to the ignition disc assembly adjacent to the illuminant. These filler rings were secured by regular commercial grade scotch (cellulose) tape. The scotch tape was chosen based on two reasons: (1) the original canister assembly production routine only required that the candles be transported between buildings inside the load plant and no rough transportation environment was expected to be encountered and (2) the chemical composition of scotch tape also met the compatibility requirement of the candle because any chemical adhesive of complex ingredients might affect the performance of the candle. The only deficiency with the tape is that the adhesive strength of scotch tape is so low that the tape will not be able to survive under any vibrations even though the candles are protected by a proper packaging system. Based on the facts that the loose filler rings caused no damage to the candle and it could be easily fixed by hand, it was decided by the end item engineer that it should not be considered as a packaging deficiency. The containers were then reconditioned at +160°F for 24 hrs.

These three containers were then subjected to the 7-ft drop test in accordance with MIL-STD-1904 at +160°F. Each container was subjected to one drop from 7 ft. The orientations were flat end, cover down 45 deg, and cover down 45 deg (opposite side). The fiberboard sheets inside the container were dented due to the weight of the candles. The candles were visually inspected and were found to be in good condition. The containers were also found to be in excellent condition with minor denting.

Tests Conducted at -65°F

Three M548 containers were subjected to secure cargo vibration at -65°F. The containers were secured to the vibration table with straps and vibrated in accordance with ITOP 1-2-601 as stated in paragraph 4.1.a. The three containers showed no damage. The candles were visually inspected with no damage found. The three containers were then reconditioned at -65°F for 24 hrs.

These three containers were then drop tested in accordance with MIL-STD-1904 from a height of 3 ft in six different orientations at -65°F similar to the test at hot temperature. After the drop tests, the containers were in excellent condition with only minor scratches. The candles were inspected with no damage found. The containers were then reconditioned at -65°F for 24 hrs.

Similarly, these three containers were subjected to loose cargo vibration in accordance with MIL-STD-1904 at -65°F as stated in paragraph 4.1.c. The containers successfully passed this test with minor scratches. One of the three containers was successfully tested for seal integrity to 3 + 0.5 psig. The candles were visually inspected with no damage found. Fiberboard filler rings were found to be loose as in the hot test. Also, some dust from the foam and fiberboard was found in the containers. The containers were then reconditioned at -65°F for 24 hrs.

These three containers were then subjected to the 7-ft drop test in accordance with MIL-STD-1904 at -65°F as stated in paragraph 4.1.d. The fiberboard sheets inside the containers were again dented due to the weight of the candles. The candles were inspected and were found to be in good condition. The containers were found to be in excellent condition with minor dents.

CONCLUSIONS

From the successful results of the environmental rough handling tests, this office concludes that the M548 metal container package for the 81-mm M853A1 Whitelight Illuminating and XM816 Infrared Illuminating Mortar Cartridges is acceptable for level B interplant shipment. Although the scotch tape used to hold the filler rings inside the candle was not strong enough to withstand rough handling tests, it was considered to be adequate by the end item engineer for the purpose. Therefore, the packing and marking drawing 12977137 was approved and is being implemented into the cartridge production.

APPENDIX

TEST PLAN

Rough Handling Test Plan for Illuminating Canister Assemblies Packaged in M548 Metal Containers

1. Conduct initial leak test of six containers.

2. Condition containers, three at 160°F, three at -65°F for 24 hours.

3. Conduct Secured Cargo Testing in accordance with MIL-STD-1904, three containers at 160°F and three containers at -65°F.

4. Recondition containers, three at 160°F, three at -65°F for 24 hours.

5. Conduct loose cargo testing (three containers at 160°F and three containers at -65°F) at 300 rpm, for 20 minutes in accordance with MIL-STD-1904. There will be one inch clearance all around the container, a steel test floor and wood walls.

6. Recondition containers, three at 160°F, three at -65°F for 24 hours.

7. Conduct three foot drop testing in accordance with MIL-STD-1904. There are six orientations, flat, opposite flat, bottom down, cover down, bottom 45 degree and cover 45 degree.

8. Inspect containers and conduct leak test.

9. Recondition containers, three at 160°F, three at -65°F.

10. Conduct seven foot drop testing in accordance with MIL-STD-1904. One drop per container. There are six orientations, flat, opposite flat, bottom down, cover down, bottom 45 degree and cover 45 degree.

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